Here is our response to the editor's technical corrections. Editor comments are in black italics and our responses are red. Please note that Figures 1, 9, and 10 have been changed from the original version, so we are also uploading new versions of these files.

P. 5 (1 of manuscript)

L. 13: I suggest you start sentences with a word and not a number.

We changed this sentence as suggested.

P. 7

L. 4: Do you need "in order"? Same elsewhere in the paper.

No, this is not needed. "in order" has been removed here and in several other places.

L. 16: But could you construct an initial B that has tracer-wind correlations?

In principle you could, but it is not clear what the climatological tracer-wind error covariance would be. Tracers may correlate better with a more conserved dynamical variable such as potential vorticity. While this is an intriguing approach that we would like to examine, it is beyond the scope of the present work.

L. 26: I think you need to provide some references here for the hybrid approach, at least for NWP. I suggest:

We included the most recent references from each center, including NRL and NCEP references (listed below) for completeness. For Environment Canada we use "Part II", rather than "Part I".

ECMWF: Bonavita, M., Isaksen, L., and Hólm, E., 'On the use of EDA background error variances in the ECMWF 4D-Var,' ECMWF Tech Memo 664. Available online at:http://www.ecmwf.int, 2012.

Environment Canada: Buehner, M., Houtekamer, P. L., Charette, C., Mitchell, H. L., and He, B.: Intercomparison of variational data assimilation and the ensemble Kalman filter for global deterministic NWP. Part II: One-month experiments with real observations, Mon. Wea. Rev., 138, 1567-1586, doi:10.1175/2009MWR3158.1, 2010.

Met Office: Clayton, A. M., Lorenc, A. C., and Barker, D. M.: Operational implementation of a hybrid ensemble/4D-Var global data assimilation system at the Met Office, Q. J. R. Meteorol. Soc, 139, 1445–1461. doi:10.1002/qj.2054, 2013.
NRL: Kuhl, D. D., Rosmond, T. E., Bishop, C. H., McLay, J., and Baker, N. L.: Comparison of Hybrid Ensemble/4DVar and 4DVar within the NAVDAS-AR data assimilation framework, Mon. Wea. Rev., 141, 2740-2758, doi:10.1175/MWR-D-12-00182.1, 2013.

NCEP: Kleist, D. T., and Ide, K.: An OSSE-based evaluation of hybrid variational-ensemble data assimilation for the NCEP GFS. Part II: 4DEnVar and hybrid variants, Mon. Wea. Rev., 143, 452-470, doi:10.1175/MWR-D-13-00350.1, 2015.

ECMWF: Buizza et al. (2008), Isaksen et al. (2010), Bonavita et al. (2012)

Met Office, UK: Clayton et al. (2013)

Environment Canada: Buehner et al. (2010)

P.10

L. 9: Is the assimilation at the beginning, middle or end of the analysis step? Please clarify.

The analysis time corresponds to the end of the 20-minute background forecast. This is now said explicitly.

P. 11

L. 8: I presume the difference between the background vector and the mean background vector is scaled by the inflation factor. Perhaps state this.

Yes, we now state this explicitly and write out the equation for clarity. We also include a reference to Anderson (2007), which discusses state space covariance inflation.

Anderson, J. L.: An adaptive covariance inflation error correction algorithm for ensemble filters, Tellus, 59A, 210-224, doi:10.1111/j.1600-0870.2006.00216.x, 2007.

P. 14

L. 28: Do you need “dramatic”? I suggest you avoid subjective statements.

We changed “dramatic” to “large”.

P. 15

L. 17: Perhaps explain further this concept of the “restarts”? 1-2 lines would suffice.

We added some text that will hopefully clarify this further.

P. 17

L. 16: What do you mean by “centered”? Centered in time? Or something else? Please clarify.

This means that the after the ensemble mean is removed, it is replaced with the 6 h offset TR fields as the new initial ensemble mean, which also defines the initial analysis. We clarified this.

L. 17: Identify the background fields – are they the short-term forecast?

No, here we are referring to the initial background fields. We now make this explicit.

P. 18

L. 7: Identify the term with the superscript “TR” (presumably the true wind).

TR refers to the truth run. We add that here.

P. 19

L. 5: Write out in full “10 day”, and then identify the acronym 10-d.

Actually, I decided to just use “10 day” in the first case and removed the second “10-d”, which was redundant.

P. 21

L. 4: I suggest “do not”.

Done

L. 7: I suggest d-> days.

Done

L. 14, 15: Use “overweigh” and “underweigh”.

Done

L. 25: Remind the reader what is “L”. You could do this in L. 21 (I assume L is the localization length).

Yes, it is the localization length. We included this on L. 21.

P.23

L. 20: Perhaps indicate that National Centers for Prediction is NCEP (the acronym is well known in the field).

Done

L. 23: Do you need “most striking”? Would ”biggest” be better, as less subjective?

Replaced “most striking” with “biggest”.

P. 24

L. 15: Why is this not surprising?

Reworded this to make it more straight-forward.

P. 25

L. 20: Do you need “further”?

Removed “further”.

L. 25: To help the reader, I suggest you remind them what is “SWM”. Same for “WEP” in L. 28, and “NMI” in L. 29, and “DA” in L. 6 of P. 26.

Done

P. 26

L. 1: I suggest you start the sentence with: “The NMI…”.

Done

P. 27

L. 19: Manuscript.

Changed “mansuscript” to “manuscript”.

P. 33

Table 1 caption: For completeness you could identify the acronyms RMSE, WEP and NMI.

Done

P. 37

Fig. 3 caption: Perhaps the authors could indicate there are no rotational modes for positive m by referring to p. 13 of the text.

Done

P. 39

Fig. 5 caption: Suggest you indicate what the ends of the colour scale indicate, as you do for other figures.

This was included in the middle of the caption. We moved it to the end for consistency.

References:

Bonavita, M., Isaksen, L., and Hólm, E. (2012). “On the use of EDA background error variances in the ECMWF 4D-Var,” in ECMWF TechMemo664. Available online at:http://www.ecmwf.int

Buehner, M., Houtekamer, P.L., Charette, C., Mitchell, H.L., and He, B. (2010). Intercomparison of variational data assimilation and the ensemble kalman filter for global deterministic NWP. Part I: description and single-observation experiments. Mon. Weather Rev. 138, 1550–1566. doi:10.1175/2009 MWR3157.1

Buizza, R., Leutbecher, M., and Isaksen, L. (2008). Potential use of an ensemble of analyses in the ECMWF Ensemble Prediction System. Q. J. R. Meteorol. Soc. 134, 2051–2066. doi:10.1002/qj.346

Clayton, A.M., Lorenc,A.C., and Barker, D.M. (2013). Operational implementation of a hybrid ensemble/4D-Var global data assimilation system at the Met Office. Q. J. R. Meteorol. Soc. 139, 1445–1461. doi:10.1002/qj.2054

Isaksen, L., Bonavita, M., Buizza,R., Fisher, M., Haseler, J., Leutbecher, M., et al. (2010). "Ensemble of data assimilations at ECMWF," in ECMWF Tech Memo 636. Available online at: http://www.ecmwf.int